Small-scale Forestry (2008) 7:295–309
DOI 10.1007/s11842-008-9056-0

RESEARCH PAPER

Tree Adoption and Nursery and Propagation Practices in Smallholder Upland Farms in Inopacan and Isabel, Leyte, the Philippines

Samuel O. Bernaldez · Eduardo O. Mangaoang

Accepted: 20 May 2008 / Published online: 24 June 2008

Abstract This paper examines seedling nursery and propagation practices in smallholder farms in two upland areas in Leyte in the Philippines. The case study areas are relatively remote, little forestry extension has been carried out, and traditional practices can be observed. These practices were examined through a survey of smallholders and observation of forestry activities. It was found that in spite of various constraints and notably the lack of planting materials, farmers are interested in forestry and are adopting some naturally growing trees and producing their own seedlings. To make way to their crops, farmers have removed some naturally growing trees of some particular species on their farms. For the purpose of introducing trees to farms, wildlings are widely used as planting material. Some farmers also collect seeds and treat them in preparation for planting, using methods which differ from those recommended elsewhere by extension agencies, but which are nevertheless highly effective.

Keywords Traditional methods · Wildlings · Seed treatment · Grafting methods

Introduction

Upland areas constitute about 60% of the Philippines total land area of 30 M ha. The majority of country's poor live in the uplands (Partap 2004). The uncontrolled migration to uplands has brought with it unabated forest denudation. O'Neil et al. (2002) citing Brown and Pearce (1994), pointed out that expanding slash and burn

Samuel O. Bernaldez is studying at Gatton Campus of The University of Queensland, on an MPhil scholarship.

S. O. Bernaldez (✉) · E. O. Mangaoang
College of Forestry and Natural Resources, Visayas State University, Visca, Baybay City, Leyte 6521, Philippines
e-mail: sammylanbern@yahoo.com

agriculture into the forest areas is the primary cause of deforestation of many parts in the tropics. The cause has been the consequence of unemployment and the expanding population. An increasing number of lowlanders has created great land pressure and consequently caused people to open forest areas for farming. In 1998 alone, about 52,681 ha of the Philippines uplands were lost to *kaingin* even though several national programs have been introduced to arrest the alarming rate of deforestation through the Department of Agriculture (DA), Department of Agrarian Reform (DAR) and Department of Environment and Natural Resources (DENR) (Partap 2004). A notable example is the Sloping Agricultural Land Technology (SALT) program. However, even with the introduction of advanced farm technologies these alarming *kaingin* activities may continue if farmers' practices are not deeply understood. Thus there is a need to document farmers' tree cultivation practices and investigate the intensity of their practices including their knowledge on tree farming systems.

Timber tree planting on small upland farms has been promoted as a way to restore degraded land and produce tree products for household consumption. In most developing countries like East African and Southeast Asian countries, the potential of smallholder tree farms to supply raw timber products in both contractual and open-market situations appears promising (Anyonge and Roshetko 2003). Bertomeu (2005) pointed out that in the Philippines, smallholder tree farmers have become major source of timber products. However smallholders' timber production practices have several limitations though their practices ensure tree survival and growth.

This article discusses Philippine upland smallholders' practices on tree adoption and nursery and propagation techniques as part of the overall tree farming system. The focus is primarily on the choice of and reasons for tree species adoption, and the availability and access of planting materials, including their germplasm production techniques.

The research reported here was conducted in smallholder upland farms of Inopacan and Isabel, Leyte in the Philippines. Specifically, the research aimed to: determine the kind of tree species adopted in the farm and the purpose of adoption; describe the techniques used to produce planting materials; and characterize germplasm access and availability.

Research Method

The study was conducted over April 7–27, 2003 in the smallholder upland farms of Barangay Conalum in Inopacan municipality and Barangay Honan in Isabel municipality, in the Leyte province. In Inopacan, although some of the people are employed, most depend on land and marine resources for their living. On the other hand, in Isabel, while the municipality is characterized by the progress of its lowlands because of the presence of prosperous industries, the uplands are gradually degrading because of the prevailing forest exploitation practices, particularly slash-and-burn activities. The sites were selected based on high population density, nature of landholdings and primary occupation, and accessibility from rural towns.

Farmers were targeted who cultivate small parcels of land, most of whom own only a very small farm area and are tenants of other farm parcels. Some upland barangays are accessible only by walk and it was a bias of the study that there had to be at least a road access and transport. Further criteria included that the area not be too far from the town proper for access to food by the interviewer, and that houses are not be too far from each other. Another important factor considered was presence of reforestation activities in these areas. Shifting of study priorities typically starts from lowlands and progresses to remote uplands, so that it was further assumed that these upland areas have received little research attention, particularly in relation to tree systems on farms.

Respondents of this survey were the resource-limited, small-scale farmers. The survey focused on farmers who were known to have been cultivating trees on their farms. The target sample size was 60, which was considered a manageable number. Simple random sampling technique was used to select the respondents. Study sites were visited and tree cultivators were identified. Courtesy calls were made to barangay captains before meeting the farmer-respondents. In Conalum, a list of the members of a tree farmers' organization (CAFA) was obtained from the organization's secretary and all of the members were automatically identified as respondents. And because the number did not satisfy the target number of respondents for the study, other farmers were identified with the help of village residents familiar with tree cultivators in the area. Likewise, in Honan a list of respondents who took part in the survey of the Isabel Community-Based Watershed Management Project (CBWMP) was obtained from the project's field enumerator, and a simple random sample was used to select respondents from the list of identified tree cultivators. Each selected respondent was informed in advance about the concept and purposes of the survey, and the date of the interview, and was subsequently visited. Assurance was given that information obtained from individual respondents would be kept confidential. Although the target sample size was 60, there were only 56 respondents in the study—26 from Conalum, Inopacan, and 30 from Honan, Isabel. Due to time constraints not all farms were visited, most of the data being derived through personal interview with the respondents at their houses.

An interview survey of smallholder households was conducted, which sought details of strategies in the establishment of trees and management of farming systems. Also, the reasons and purposes for and perceived benefits by smallholder farmers in cultivating trees were examined. The interview schedule was prepared in English and mostly open-ended questions were used. For easy questioning, it was translated to the *Cebuano* dialect of the respondents. To determine the appropriateness and whether improvements were needed, it was tested through personal interview of three farmers in Inopacan, Leyte. After the testing few minor changes were made.

All interviews were carried out by the first author. In Conalum, immersion to the study sites was made possible by riding on a public tricycle from the town proper. Almost all of the farmer-respondents are living in the lowland but all were upland farmers. On the other hand, the only possible way to reach Barangay Honan in Isabel was through a passenger motorbike locally known as '*habal-habal*'. Staying

at a farmer's house was the only way to continue with the survey over several days or a week, as well as being a strategy to gain more insights about the general characteristics of the selected farmers and to assess the peace and order situation of the area. Although during the time of interview insurgents were believed to be present in Honan, there were no incidents which could be related to their presence. Two farmers in Isabel were not available at the times of the first and second visits to their houses because of their harvesting activities, and these were replaced by other farmers available during the time of stay in the area.

Data were collected through semi-informal interviews of the selected respondents and farm observations recorded in a notebook. Also, photographs reflective of the objectives of the study were taken for documentation purposes. Data were tabulated and analyzed using simple descriptive statistics and also a weighted score parameter about tree species selection and preference.

Characteristics of the Sample

Socio-demographic Characteristics

The majority of respondents (41% or 73%) were male. Other than farming as the primary occupation, small numbers mentioned carpentry, welding, dealing in upland products, and mat-making. Only 4% of respondents had no schooling, though only 4% had proceeded beyond high school education. About 59% had a permanent (concrete and iron-roofed) house, 59% were older than 50 years, and 80% had a family member other than the respondent contributing to farm work.

Farm and Farming Characteristics

Table 1 reports data about the nature of the farm being cultivated by the interviewed farmers including their farming experience. Three-quarters of the respondents owned some parcels of land; some respondents owned a farm parcel and tenanted another. In terms of farm size (total area of all farm parcels being cultivated by a respondent), 84% worked a total area of 2 ha or less.[1] There were seven base land-use systems in terms of the most important enterprise, with coconuts accounting for the greatest land area (55%). A tree system was mentioned by two respondents who grew a single species only (one grew mahogany and the other gmelina). Root crops included sweet potato, taro, cassava, and yam, while the main vegetables grown were eggplant, beans, okra, squash, bitter gourd and alugbati.[2] Over half the respondents (52%) had been farming for more than 20 years, the average period being nearly 27 years.

[1] Selection of the sample was biased towards small blocks. The original intention was to limit the sample to farmers operating 2 ha or less, but during the survey it was discovered that some operated additional blocks.

[2] Alugbati is a green leafy vegetable usually served cooked, e.g. mixed in fish soup.

Table 1 Farm and farming characteristics of respondents

Item	Category	Frequency	Relative frequency (%)
Tenure status of the farm[a]	Owned	42	75
	Tenanted	26	46
Farm size	<1 ha	24	43
	1–2 ha	23	41
	>2 ha	9	16
Total		56	100
Base land-use system[a]	Coconuts	31	55
	Rice	24	43
	Root crops	18	32
	Corn	10	18
	Vegetables	5	9
	Abaca	4	7
	Trees	2	4
No. of years in farming (mean = 26.80 years)	<10	1	2
	10–20	26	46
	21–30	18	32
	31–40	5	9
	>40	6	11
Total		56	100

[a] Some farmers have more than one farm parcel, hence the total percentage exceeds 100

Tree Species Adopted on Farms

Table 2 ranks the 36 tree species which were mentioned by respondents as adopted on their farms. Among the 36 species mentioned, 14% were not clearly specified in terms of scientific name, and only their local name is reported in the list. It is probable that the number of species and the number of times the species was mentioned are underestimated.

In terms of reporting frequency of tree species, *Gmelina arborea* ranks highest (59%) followed by *Swietenia* spp., while several native species rank lowest in the list. The main factor that affected farmers' adoption was the availability of planting materials. Gmelina as an exotic species was introduced for cultivation and has been planted in great numbers throughout Leyte province, the seed being widely available and easy to collect. Respondents found some gmelina wildlings as best for cultivation when the seeds had germinated after being distributed as excreta of animals including cows and carabao. On the other hand, several native species were adopted only after being naturally regenerated on the farms (i.e. wildlings grown in situ).

The most frequently grown species were those which can be utilized as construction materials or are fruit bearing. Conversely, those which are only perceived as important in the maintenance and improvement of the farm ecosystem receive lower rankings. One respondent pointed out that *Ficus nota* was the best for water conservation; this species grows naturally where there is creek or stream nearby.

Table 2 Species adopted on farms

Local name	Common name	Scientific name	Family	No. of respondents	Relative frequency (%)	Rank
Gmelina	Yemane	*Gmelina arborea*	Verbenaceae	33	59	1
Mahogany	Mahogany	*Swietenia* spp.	Meliaceae	25	45	2
Biyatilis	Ipil-ipil	*Leucaena* spp.	Mimosaceae	18	32	3
Mangga	Mangga	*Mangifera indica*	Anacardiaceae	12	21	4
Madre de cacao	Kakawate	*Gliricidia sepium*	Fabaceae	11	20	5
Langka	Nangka	*Artocarpus heterophylla*	Moraceae	10	18	6
Bagawnga	Bagalunga	*Melia dubia*	Meliaceae	10	18	6
Antipolo	Antipolo	*Artocarpus blancoi*	Moraceae	8	14	8
Tugas	Molave	*Vitex parviflora*	Verbenaceae	7	12	9
Bagras	Bagras	*Eucalyptus deglupta*	Myristicaceae	7	12	10
Santol	Santol	*Sandoricum koetjape*	Meliaceae	5	9	11
Kaimito	Kaimito	*Chrysophyllum caimito*	Sapotaceae	4	7	12
Abokado	Abokado	*Persia americana*	Lauraceae	3	5	13
Acacia	Rain tree	*Samanea saman*	Mimosaceae	3	5	13
Kakaw	Kakaw	*Theobroma cacao*	Sterculiaceae	3	5	13
Mangium	Mangium	*Acacia mangium*	Mimosaceae	3	5	13
Marang	Marang	*Litsea perrottetti*	Lauraceae	3	5	13
Anabiong	Anabiong	*Trema orientalis*	Ulmaceae	2	4	18
Binunga	Binunga	*Macaranga tanarius*	Euphorbiaceae	2	4	18
Hagakhak	Hagakhak	*Dipterocarpus warburgi*	Dipterocarpacea	2	4	18
Naga	Narra	*Pterocarpus* spp.	Fabaceae	2	4	18
Pili	Pili	*Canarium ovatum*	Burseraceae	2	4	18
Rambutan	Rambutan	*Nephelium lappaceum*	Sapindaceae	2	4	18
Anii	Anii	*Erythrina fusca*	Fabaceae	1	2	24
Banahaw	–	–	–	1	2	24
Bangkaw	Bangkal	*Nauclea orientalis*	Naucleaceae	1	2	24
Doldol	Kapok	*Celba pentandra*	Bombaceae	1	2	24
Durian	Durian	*Durio zibethinus*	Bombaceae	1	2	24
Gaway-gaway	–	–	–	1	2	24
Hagbuyo	–	–	–	1	2	24
Kalabana	Guyabano	*Annona muricata*	Annonaceae	1	2	24
Kaporme	–	–	–	1	2	24
Magbiyabas	Malabiyas	*Tristania decorticata*	Myristicaceae	1	2	24

Table 2 continued

Local name	Common name	Scientific name	Family	No. of respondents	Relative frequency (%)	Rank
Sagasa	–	–	–	1	2	24
Sambag	Sampalok	*Tamarindus indica*	Caesalpiniaceae	1	2	24
Tubog	Tibig	*Ficus nota*	Moraceae	1	2	24

Choice of Tree Species and Criteria for Selections

Trees cultivated on farms were either planted or naturally regenerated. Some claimed they felled some trees naturally regenerated to make way for crops. Their choice on trees for adoption was based more on perceived economic rather than environmental benefits of the species.

Farmers were asked what characteristics they considered in the selection of species they adopted. Most (61%) were not able to identify any characteristics and were emphatic to say that they only cultivated what was available. The remainder listed between one and four characteristics. To compare the overall ranking with the collected data, the potential of the use of *weighted score* parameter was based on the AFRENA report:

$$\sum_{r=1}^{m} (\text{no. of times mentioned with rank r}) \times (m + 1 - r)$$

where r is the rank of the characteristic reported by the respondent, and m is the maximum ranking (of 4). Table 3 lists the various characteristics mentioned, with their rankings and weighted scores. There are two types of ranks—the selection criteria (s) and preferred trait (p).

Table 3 lists the characteristics mentioned as selection criteria. Most farmers adopted *Gmelina arborea* which is a fast growing species. As a consequence, fast growth receives the highest weighted score, and ranks highest when comparing in terms of first ranks. This result suggests that growth rate was a highly regarded characteristic because farmers wanted to realize the outcome of their tree cultivation endeavour in the shortest possible time. Three respondents also mentioned that growth characteristics of a species determine some other characteristics, pointing out that fast growing species are usually straight boled, large-diameter and tall trees, although observation on the smallholder tree farms suggests that *Gmelina arborea*, a fast-growing species, often has poor form.

'Stem straightness' ranks second when compared by first rankings, and is followed by 'stem size or length'. These characteristics have equal ranks when comparing the weighted scores. Farmers who mentioned these characteristics considered timber and poles or posts as the most important product of the tree species. They could utilize the timber as construction material for their own farms, and sell excess logs.

Two respondents mentioned size of the crown as a criterion. Crown size determines the degree of competition with agricultural crops for sunlight, and hence

Table 3 Importance and weighted score of characteristics for selection or preference of tree species

Characteristics	No. of times mentioned as selection criterion (s) and preferred trait (p), and total number of times (t) mentioned with ranking of 1–4				Weighted score
	1	2	3	4	
Fast growth	8(s),23(p),31(t)	3(s),12(p),15(t)	4(s),3(p),7(t)	–	49(s),134(p),183(t)
Straight bole	5(s),10(p),15(t)	8(s),15(p),23(t)	3(p/t)	–	44(s),91(p),135(t)
Big and tall tree	4(s),4(p),8(t)	6(s),5(p),11(t)	5(s),4(p),9(t)	2(p/t)	44(s),41(p),85(t)
Fine grain wood	2(s),6(p),8(t)	2(s),7(p),9(t)	9(s),2(p),11(t)	1(p/t)	32(s),50(p),82(t)
Fruit-bearing	1(s),3(p),4(t)	2(s),2(p),4(t)	–	–	10(s),18(p),28(t)
Small crown	1(s),1(p),2(t)	2(p/t)	–	1(s),2(p),3(t)	5(s),12(p),17(t)
Deep-based roots	–	–	2(p/t)	5(p/t)	9(p/t)
Self-pruning	–	1(p/t)	–	4(p/t)	7(p/t)
Many branches	1(s/t)	–	1(p/t)	–	4(s),2(p),6(t)
Toxic wood	–	–	2(p/t)	–	4(p/t)
Medicinal	–	–	–	1(s),1(p),2(t)	1(s),1(p),2(t)

the number of trees that can be grown on a given farm area. This characteristic was important for two farmers who practiced monoculture tree farming.

One farmer explained that ‘many branches’ was a criterion he considered in deciding to cultivate *Samanea saman*. He wanted a tree which provides shade protection for crops and provides a place for a ‘few minutes’ rest after performing some tiresome farming activities. He further stated that with this characteristic, he could cut some ‘big enough’ branches for fuelwood while the tree is maturing.

Preferred Species and Characteristics

Respondents were also asked what species and characteristics of trees they would prefer to plant, if all necessary resources were available. Unexpectedly, only a few respondents (14%) enumerated species choices. Among them, 88% mentioned mahogany *(Swietenia macrophylla)*, 75% bagras *(Eucalyptus deglupta)*, 50% mango *(Mangifera indica)*, 38% yakal *(Parashorea astylosa)* and yemane (*Gmelina arborea*), and 12% bagalunga *(Melia dubia)* and ipil-ipil *(Leucaena leucocephala)*. This should not be interpreted as implying that farmers do not wish to plant trees, but rather they do not expect that free seedlings will be available of the species they prefer to plant. All wanted to plant any kind of trees which are of high quality (mostly in terms of timber), but they had difficulty obtaining planting materials. However, most (84%) enumerated characteristics they preferred for a species when asked about it (Table 3).

A weighted parameter was calculated for preferred characteristics. As indicated in Table 3, 11 characteristics were mentioned as preferred traits. These included fast growth, straight bole, big and tall tree, small crown, and branching characteristics, as in the analysis of characteristics for selection. Fruit bearing was mentioned by

four farmers who preferred mango. They explained that they wanted to derive benefits while the tree is maturing.

The kind of wood the species would produce was also emphasized by some respondents (32%). Fineness of grain and termite resistance were mentioned as best for construction materials as these characteristics determine the longevity of their service. These traits were mentioned by those who preferred yakal and yemane, respectively.

'Deep-based roots' was emphasized by respondents who have negative perceptions about their yemane trees. They explained that with deep roots, their crops would not suffer from competition for growth factors. Further, they pointed out that deep roots would extract nutrients and minerals from the sub-soil and make them available for crops when leaves are shed.

Tendency to shed branches was mentioned by 9% of the respondents. These responses were mostly from those who preferred bagras, who noted the difficulty in pruning tall trees. Some further stated that with self-pruning trees, they would not have problems with infection by microorganisms of pruning scars. One farmer who preferred mahogany mentioned medicinal uses as his fourth preferred trait, the seeds and leaves of this species being perceived to an alternative medicine for stomach ache, and dysmenorrhoea.

From these varying responses, it could be concluded that farmers are both practical and scientific. However, most of their views are associated with their tangible desires in the form of physical output of timber, rather than environmental services of their trees. Further, the preference characteristics they mentioned appear to be the determinants of what seems important product they could derive from the species.

Availability of Planting Material

In the context of tree cultivation endeavor, availability of planting materials is always the primary consideration. The sources, kind or form, and the ways to obtain planting material were examined. Survey findings are summarized in Table 4.

A wide variety of sources of planting materials was reported. Some respondents obtained them from communal lands (66%), adjacent vegetation (57%), their own farm (47%) and timberland (25%). Planting materials were also available from some institutions, including the Visayas State College of Agriculture or ViSCA (now Visayas State University), and Isabel National Agricultural and Vocational School. One respondent explained that, in an indirect way, a place where he could buy fruits including mangoes was a seed source.

In the interviews, five forms of planting materials were identified; most respondents mentioned more than one form though none mentioned all five. Wildlings were mentioned by 71% of the respondents as this form could be found in any natural environment, and for same reason; 25% mentioned seed and 18% cuttings which could also be collected easily. Those who mentioned seedlings (29%) obtained these from three sources: namely institutions and associations such as Conalum Agroforestry Farmers Association (CAFA) of Inopacan; projects such

Table 4 Source, form, and means of securing planting materials

Characteristics	Category	Frequency of mentions[a]	Relative frequency (%)
Source	Communal lands	37	66
	Adjacent vegetation	32	57
	Own farm	26	46
	Timberland	14	25
	Institution	9	16
	Association/project	8	14
	Local nursery	6	11
	Neighboring farms	2	4
	Municipal Office of Agriculture (MOA)	1	2
	Market	1	2
Form	Wildling	40	71
	Seedling	16	29
	Seed	14	25
	Cutting	10	18
	Grafted	6	11
How secured	Freely collected	42	75
	Purchased	10	18
	Asked for/given as free	8	14
	Credited[b]	1	2

[a] Individual respondents provided multiple responses for each of the categories of source, form and how secured

[b] Seedling were dispersed by the government through the Municipal Agricultural Office. Smallholders had free access to planting materials, although it was stated that they would be required to pay for the seedlings once income was realized from fruits or timber produced

as the Australian Centre for International Agricultural Research (ACIAR) Smallholder Forestry project; and local nurseries including Central Inopacan and Tahud nurseries. Use of grafted stock was mentioned by three respondents, two of whom derived this material from an institution (mango from ViSCA), one from municipal office of agriculture (mango and jackfruit from Abuyog), and three produced grafted materials themselves.

As to the means of securing planting materials, 18% said that they purchased them at some institutions (PhP 1.25 per mahogany or gmelina seedling, during the late 1980s to early 1990s),[3] and from local nurseries (same price and period as from institutions but with free delivery), 75% said that they derived planting materials freely from their surrounding or from a natural stand by uprooting wildlings or collecting seeds (e.g. of ipil-ipil). There were no mentions of seed purchases. Some of the members of CAFA were fortunate when excess planting materials (bagrass and mangium seedlings) from ACIAR Smallholder Forestry Project were provided without charge. One respondent mentioned that he obtained grafted materials (mango and jackfruit at P50 and P45 each, respectively) from the government 'plant now pay later' scheme. The small number of respondents who were able to purchase

[3] $US 1 = 45 Philippine pesos, approximately.

planting materials suggests that majority of them were financially constrained or did not have enough information as to a source of such materials.

Nursery and Propagation Practices

Although only eight respondents used seeds to produce planting stock and about 13 practiced production of vegetative planting materials, it is still worthwhile to consider the intensity of their practices. Only small numbers of seeds were sown, and there was no need to put up nursery structures. Ten percent of respondents who did not plant seeds also provided comments on use of seeds. Three of the six respondents who utilized grafted materials had hands-on experience in the grafting process.

Due to time constraints not every detail of the practice was investigated; only 'direct to the point' responses were noted. The majority of those who engaged in seedling production mentioned four major undertakings: germination, pricking, transplanting and watering. Actual seed germination of yemane and mahogany was done in polybags or, in some cases, empty tin cans. Some also germinated small-sized seeds such as bagras and mangium in seed boxes. Pricking was done when seeds had already germinated and the pricked seedlings were transplanted to polybags and ordinary cellophane as potting materials. Pricking and transplanting were not mentioned in sown gmelina and mahogany seeds. Further there was no mention about watering and number of leaves to be considered during pricking. Seedlings should be watered to soften the soil before pricking, and the decision about when seeds are to be pricked should be based on the number of leaves developed, usually at least two pairs. Perhaps they were aware of the proper pricking procedures but had only forgotten to mention them.

Apart from economic benefits of trees, cuttings were primarily used for marking farm boundaries. Depending on the availability of materials and purpose of planting, main stems or big and small branches of particular species were utilized.

Seed Collection and Storage

As reflected in Table 4, only a small proportion of farmers (25%) used seeds as planting materials, which suggests there is a lack of information about seeds. However, in response to a particular question, some farmers (10%) who did not engage in seeds had some ideas about raising seedlings. Seeds (particularly for gmelina and mahogany) were collected from natural stand of trees in the immediate vicinity of farms. There was no mention about seed selection because farmers would just obtain whatever seeds are available, without any selection of mother trees. Six farmers collected seed of ipil-ipil from natural vegetation adjacent to their farms; this seed was dry enough for direct sowing on their farms.

Among those who dealt with seeds of gmelina and mahogany, seed processing was mentioned, but nothing was said about seed storage, although there were claims about a few days delay before sowing the seeds. In seed processing, the outer covering of gmelina seeds was removed, and in the case of mahogany seeds, part of the wings were cut off, after which the seeds were sun-dried.

Seed Treatments to Hasten Germination

Among the respondents who utilized seeds, 57% had experiences on seed germination treatments. A few others (10%) had only ideas they learnt through acquaintances and from seminars. Table 5 reports the treatments mentioned for various tree species, as well as farmers' knowledge about the number of days to germination with or without treatments.

Only nine species were mentioned for which farmers had ideas on pre-sowing treatments. Treatments of most species are yet to be explored by the farmers. The most common treatment mentioned 18 times and applying to four species) is sun-drying. However, in the hand-outs sun-drying as a pre-sowing treatment is never mentioned for any species. It is only a seed storage preparation activity, especially for non-fruit tree species. Further, sun-drying is impractical for some fruit trees, including jacfruit *(Artocarpus heterophyllus)* and mango *(Mangifera indica)*. Direct sowing of such seeds after extraction is recommended, with air-drying for a day or two advised for storing. Many of the farmers' ideas on treatments do not correspond with recommendations in the literature. It is evident that some farmers were interested to learn seed growing through 'common sense' experimentation.

Data on the number of days to germination under the various treatments came from farmers who had practiced seed treatments, and by some farmers who had not but were still prepared to make estimates. Data on germination without seed treatment came from farmers who repeatedly planted the same seeds directly on-farm, including two (out of six) farmers who planted *Leucaena leucacephala* seeds and one who planted *Mangifera indica*. Most respondents did not bother to take note of the number of days to germination of their seeds, and appeared to consider that sooner or later seeds will germinate, the time depending on prevailing natural conditions. However, it is necessary to have knowledge about how to avoid a long germination period, and perhaps the decision to replant because seeds have not germinated in the expected period.

Vegetative Planting Material Production Practices

As reported in Table 4, 29% of respondents mentioned the use of vegetative propagation; 18% of respondents utilized cuttings and 5% carried out grafting. This very low percentage indicates that information on vegetative propagation has yet to be disseminated among upland farmers.

In the use of cuttings, four species were reported to have the highest survival rate, namely kakawate, ipil-ipil, gaway-gaway and yemane. Cutting sizes (length and diameter) mentioned ranged from 60 cm long with less than 2.5 cm diameter to 1.5 m long with 5–7.5 cm diameter.[4] Usually when cuttings were used as fence posts to mark farm boundaries, larger sizes were utilized. This practice utilized the major stem of the tree when branches are not yet big enough, as mentioned by 11% of the respondents. With this procedure, trees from adjacent vegetation may be

[4] These dimensions were reported by citing objects to mean a size (i.e. showing a thumb to mean the diameter).

Table 5 Pre-sowing treatments and number of days to germination

Species	Mentioned by respondents[a]			Mentioned in literature[b]		
	Treatment/preparation	Days to germination with or without treatment		Treatment/preparation	Days to germination with or without treatment	
		W	W/o		W	W/o
Acacia mangium	Pour out hot water into a container with seeds (4)			Immerse for 30 s in boiling water and soak overnight in cold water	3–6	5–20
Artocarpus heterophyllus	Sundry the seeds then remove seed covering (1)	7–14 (1)		Remove seed 'jacket', wash and soak for 24 h in cool water	3–5	14
Eucalyptus deglupta	Soak in hot water (1), or pour hot water onto seeds (1)	<7 (3)		None required		3–8
Gmelina arborea	Remove outer covering then sundry (8)	<30 (4)		Soak in cold water for 48 h	7–14	14–28
Leucacena spp.	Place seeds in used socks and dip in boiling water (2), or nicking of seed coat (1)		7–14 (2)	Immerse in boiling water for 2 min and soak in tap water overnight	5–12	12–20
Mangifera indica	Sundry the seeds for few days then remove husk (4)	7–14 (2)	30 or less (1)	Remove husk to improve quality and uniformity of seedlings	10–15	36
Samanea saman	Immerse in hot water until water cools off (2)			Immerse in hot water for 3 min and soak overnight in cool water	7–15	16–25
Swietenia spp.	Pour hot water into a container with seeds (2), or immerse in boiling water for not more than 1 min (3), or sundry (5) with wings already broken off	7–14 (5)		Soak in hot water (50°C) for 5 min and then break off seed wings	8–14	14–28
Vitex parviflora	Carefully pound the fruit to break and remove hard covering then soak in tap water (1)			Remove pericarp (hard covering) of fruit	5–10	10–20

[a] Numbers in parentheses represent number of responses per mentioned treatment or days to germination

[b] This information was provided in nursery hand-outs prepared at the Department of Forestry, Central Mindano University

exploited as vegetative materials, in which case only stumps will re main. In contrast, the use of small-sized cuttings is a sustainable practice because only minor branches are utilized leaving the whole tree intact. Cuttings were also used for trellises in growing vine crops.

Attempts to graft mangoes were mentioned—two were successful, one was not. All of the three who carried out grafting used cellophane to wrap the newly grafted material, although one of them further mentioned the use of wet cloth.

Concluding Comments

Farmers' tree cultivation is related to their perceptions on the roles of trees in their farming system. Perceptions were mostly reflective of their objectives towards the system. Most of these objectives are physical or economic in nature. Planting of trees was mostly done when there is availability of planting materials. Most farmers planted wildlings derived from natural surroundings and seeds collected from tree stands. Some natural regeneration was also considered for domestication.

While some parts of Leyte have successful community and smallholder nurseries (Gunasena and Roshetko 2000; Gregorio et al. 2007), few nurseries are to be found in upland areas. Upland farmers have interest in tree cultivation and need information about it. Few respondents were engaged in or had knowledge about such practice. Thus, there is a need to facilitate gradual and systematic information dissemination of better and advanced practices for nursery and propagation techniques to these areas.

In view of the general findings of the study, it can be concluded that smallholder upland farmers have diverse ideas about tree cultivation practices. However, their diversity of ideas does not fully guarantee success of the farming system because theirs were more on 'common sense' approaches rather than scientific.

Because transfer of information on technological advances does not readily reach the uplands due to their remoteness from information centres, technologies did not reach the smallholder farmers, hence, knowledge is not fully put into practice. Despite perceived constraints to the tree farming system, farmers are still interested to plant trees if planting materials are available.

Acknowledgements We would like to express our most sincere thanks to the Australian Centre for International Agricultural Research (ACIAR) Smallholder Forestry Project for the provision of financial support which was vital to the success of this research. Our sincere appreciation goes to the smallholder upland farmers of Inopacan and Isabel municipalities for their enthusiastic participation in this study. We are also very grateful to Dr Steve Harrison for his untiring editing which put this research writing into a more organized report.

References

AFRENA (1977) Local perceptions on tree propagation and domestication. Results from a survey in Western Kenya. AFRENA Report no. 115. ICRAF, Nairobi

Anyonge CH, Roshetko JM (2003) Farm-level timber production: orienting farmers towards the market. Unasylva: Making Forestry Pay 54(212). http://www.worldagroforestrycentre.org/Sea/Publications/files/journal/JA0215-05.PDF. Accessed 6 Sept 2007

Bertomeu M (2005) Small-scale farm forestry: an adoptable option for smallholder farmers in the Philippines? 2nd National Agroforestry Congress: international consultation workshop on smallholder agroforestry options for degraded soils (SAFODS). World Agroforestry Centre (ICRAF), SEA Regional Office Malang, Indonesia. http://www.worldagroforestry.org/sea/Publications/files/paper/PP0189-06.PDF. Accessed 6 Sept 2007

Gunasena HPM, Roshetko JM (2000) Tree domestication in Southeast Asia: results of a regional study on institutional capacity for tree domestication in national programs. ICRAF/Winrock International, Bogor

Gregorio NO, Herbohn JL, Harrison SR (2007) The operational effectiveness of the forest nursery sector in Leyte, the Philippines. In: Harrison SR, Bosch A, Herbohn JL (eds) Improving the triple bottom line returns from small-scale forestry. Proceedings from an international conference held in Ormoc City, the Philippines, 18–21 June 2007, Brisbane, pp 155–165

O'Neil GA, Dawson I, Montes CS, Guarino L, Weber JC (2002) Genetic conservation of tropical trees. Overstorey no. 97. Permanent Agriculture, Holualoa

Partap T (ed) (2004) Sustainable farming systems in upland areas. Report of the APO study meeting on sustainable farming systems in upland areas, New Delhi, 15–19 Jan 2001. Asian Productivity Organization, Tokyo. http://www.apo-tokyo.org/00e-books/AG-02_SustFarming/AG-02_SustFarming.pdf. Accessed 6 Sept 2007